



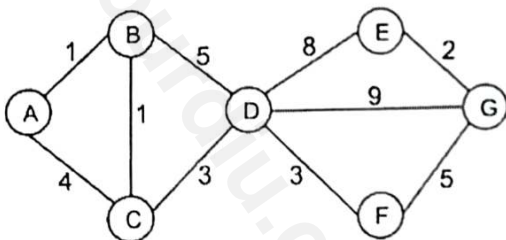
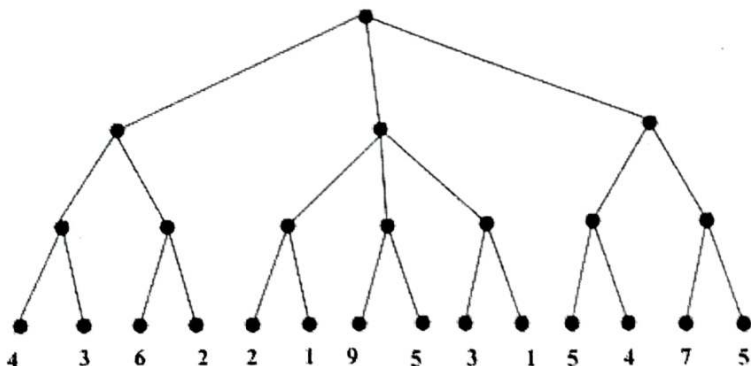
Daffodil International University  
Faculty of Science & Information Technology  
Department of Computer Science and Engineering  
Final Examination, Spring-2026  
Course Code: CSE-316, Course Title: Artificial Intelligence  
Level: 3 Term: 3 Batch: 65

Time: 02:00 Hours

Marks: 40

Answer ALL Questions

[The figures in the right margin indicate the full marks and corresponding course outcomes. All portions of each question must be answered sequentially.]

| 1.    | <p>(a) <b>State</b> the equation used in A* search strategy. In the state space graph shown in Figure 1(a), 'A' is the start state and 'G' is the goal state. The costs for each edge are shown on the graph. Each edge can be traversed in both directions. Prove that the shortest path is <math>S = \{A \rightarrow B \rightarrow C \rightarrow D \rightarrow F \rightarrow G\}</math>, by applying A* search strategy. The corresponding heuristic table is presented in Table 1(a).</p> <div><table><caption>Table 1(a): Heuristic value table</caption><tr><th>Nodes</th><th>Heuristics (<math>h_1</math>)</th></tr><tr><td>A</td><td>9.5</td></tr><tr><td>B</td><td>9</td></tr><tr><td>C</td><td>8</td></tr><tr><td>D</td><td>7</td></tr><tr><td>E</td><td>1.5</td></tr><tr><td>F</td><td>4</td></tr><tr><td>G</td><td>0</td></tr></table><p>Figure 1(a): An example state space graph</p></div> | Nodes | Heuristics ( $h_1$ ) | A | 9.5 | B | 9 | C | 8 | D | 7 | E | 1.5 | F | 4 | G | 0 | 5 | CO3 |
|-------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|----------------------|---|-----|---|---|---|---|---|---|---|-----|---|---|---|---|---|-----|
| Nodes | Heuristics ( $h_1$ )                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |       |                      |   |     |   |   |   |   |   |   |   |     |   |   |   |   |   |     |
| A     | 9.5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |       |                      |   |     |   |   |   |   |   |   |   |     |   |   |   |   |   |     |
| B     | 9                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |       |                      |   |     |   |   |   |   |   |   |   |     |   |   |   |   |   |     |
| C     | 8                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |       |                      |   |     |   |   |   |   |   |   |   |     |   |   |   |   |   |     |
| D     | 7                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |       |                      |   |     |   |   |   |   |   |   |   |     |   |   |   |   |   |     |
| E     | 1.5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |       |                      |   |     |   |   |   |   |   |   |   |     |   |   |   |   |   |     |
| F     | 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |       |                      |   |     |   |   |   |   |   |   |   |     |   |   |   |   |   |     |
| G     | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |       |                      |   |     |   |   |   |   |   |   |   |     |   |   |   |   |   |     |
|       | <p>(b) <b>Define</b> Genetic Algorithm. Describe the pipeline (steps) of Genetic Algorithm strategy with an appropriate example.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 5     |                      |   |     |   |   |   |   |   |   |   |     |   |   |   |   |   |     |
|       | <p>(c) For the adversarial search tree given in Figure 2(a), <b>identify</b> the optimal strategy from Max's perspective using Alpha-Beta pruning algorithm. Values of 'v' at each node should be mentioned clearly, also the branches that are pruned should be marked clearly.</p> <div><p>MAX</p><p>M</p><p>MAX</p><p>4 3 6 2 2 1 9 5 3 1 5 4 7 5</p><p>Figure 2(a): Adversarial search tree example</p></div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 5     |                      |   |     |   |   |   |   |   |   |   |     |   |   |   |   |   |     |

| 2.                                                                                                                                                                                                                                                                                                                                                                                                                                        | (a)                            | Consider a sentence, $\phi = (\neg p \vee q) \wedge (q \rightarrow \neg r \wedge \neg p) \wedge (p \vee r)$ . Apply first order logic to <b>identify</b> that $\phi$ is satisfiable.                                                                                                                                                | 5                 | CO4 |           |                                                            |                 |                                                             |                            |                                                  |          |                                                       |            |   |                              |           |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|-----|-----------|------------------------------------------------------------|-----------------|-------------------------------------------------------------|----------------------------|--------------------------------------------------|----------|-------------------------------------------------------|------------|---|------------------------------|-----------|
|                                                                                                                                                                                                                                                                                                                                                                                                                                           | (b)                            | A doctor knows that tuberculosis causes a persistent cough in 80% of cases. The prior probability that a patient has tuberculosis is 2 out of 400 patient, and the probability that any patient has a cough is 10%. <b>Solve</b> the probability that a patient has tuberculosis given that they have a cough.                      | 5                 |     |           |                                                            |                 |                                                             |                            |                                                  |          |                                                       |            |   |                              |           |
|                                                                                                                                                                                                                                                                                                                                                                                                                                           | (c)                            | For the following primary dataset shown in Table 3(b), <b>apply</b> the Bag of Words (BoW) concept of Natural Language Processing to <b>prepare</b> a clean dataset for AI system training.                                                                                                                                         | 5                 |     |           |                                                            |                 |                                                             |                            |                                                  |          |                                                       |            |   |                              |           |
| Table 3(b): Primary dataset of emotion classification                                                                                                                                                                                                                                                                                                                                                                                     |                                |                                                                                                                                                                                                                                                                                                                                     |                   |     |           |                                                            |                 |                                                             |                            |                                                  |          |                                                       |            |   |                              |           |
| <table><tr><th>Social Media post</th><th>Sentiment</th></tr><tr><td>This war is heartbreaking, so many innocents are affected.</td><td>Negative</td></tr><tr><td>The situation is complicated, and both sides are suffering.</td><td>Neutral</td></tr><tr><td>Diplomacy seems like the only real solution now.</td><td>Positive</td></tr><tr><td>Some actions taken in this war are deeply concerning.</td><td>Negative</td></tr></table> |                                |                                                                                                                                                                                                                                                                                                                                     | Social Media post |     | Sentiment | This war is heartbreaking, so many innocents are affected. | Negative        | The situation is complicated, and both sides are suffering. | Neutral                    | Diplomacy seems like the only real solution now. | Positive | Some actions taken in this war are deeply concerning. | Negative   |   |                              |           |
| Social Media post                                                                                                                                                                                                                                                                                                                                                                                                                         | Sentiment                      |                                                                                                                                                                                                                                                                                                                                     |                   |     |           |                                                            |                 |                                                             |                            |                                                  |          |                                                       |            |   |                              |           |
| This war is heartbreaking, so many innocents are affected.                                                                                                                                                                                                                                                                                                                                                                                | Negative                       |                                                                                                                                                                                                                                                                                                                                     |                   |     |           |                                                            |                 |                                                             |                            |                                                  |          |                                                       |            |   |                              |           |
| The situation is complicated, and both sides are suffering.                                                                                                                                                                                                                                                                                                                                                                               | Neutral                        |                                                                                                                                                                                                                                                                                                                                     |                   |     |           |                                                            |                 |                                                             |                            |                                                  |          |                                                       |            |   |                              |           |
| Diplomacy seems like the only real solution now.                                                                                                                                                                                                                                                                                                                                                                                          | Positive                       |                                                                                                                                                                                                                                                                                                                                     |                   |     |           |                                                            |                 |                                                             |                            |                                                  |          |                                                       |            |   |                              |           |
| Some actions taken in this war are deeply concerning.                                                                                                                                                                                                                                                                                                                                                                                     | Negative                       |                                                                                                                                                                                                                                                                                                                                     |                   |     |           |                                                            |                 |                                                             |                            |                                                  |          |                                                       |            |   |                              |           |
| 3.                                                                                                                                                                                                                                                                                                                                                                                                                                        | (a)                            | Consider a system with four inputs and a single output. Design a single-neuron architecture for this system, including the necessary mathematical formulation. <b>Clarify</b> the process of determining the initial weight matrix and explain two suitable activation functions, along with their appropriateness for the problem. | 5                 | CO4 |           |                                                            |                 |                                                             |                            |                                                  |          |                                                       |            |   |                              |           |
|                                                                                                                                                                                                                                                                                                                                                                                                                                           | (b)                            | For the above design (Q4(a)), consider the updated weight vector after some iteration is $W = [0.8 \ -0.6 \ 0 \ 0.3]^T$ . <b>Apply</b> and <b>analyze</b> the 3 (three) iterations of the Perceptron Learning rule for the designed system. Consider the following inputs, desired outputs, and learning rate as $\eta = 0.1$ .     | 5                 |     |           |                                                            |                 |                                                             |                            |                                                  |          |                                                       |            |   |                              |           |
| Table 4(b): Inputs and desired outputs                                                                                                                                                                                                                                                                                                                                                                                                    |                                |                                                                                                                                                                                                                                                                                                                                     |                   |     |           |                                                            |                 |                                                             |                            |                                                  |          |                                                       |            |   |                              |           |
| <table><tr><th>Iteration</th><th>Inputs</th><th>Desired outputs</th></tr><tr><td>1</td><td><math>x_1 = [1 \ -2 \ 0 \ 1]^T</math></td><td><math>d_1 = -1</math></td></tr><tr><td>2</td><td><math>x_2 = [0 \ 1.5 \ -0.5 \ 1]^T</math></td><td><math>d_1 = -1</math></td></tr><tr><td>3</td><td><math>x_3 = [-1 \ 1 \ 0.5 \ 1]^T</math></td><td><math>d_1 = 1</math></td></tr></table>                                                       |                                |                                                                                                                                                                                                                                                                                                                                     |                   |     | Iteration | Inputs                                                     | Desired outputs | 1                                                           | $x_1 = [1 \ -2 \ 0 \ 1]^T$ | $d_1 = -1$                                       | 2        | $x_2 = [0 \ 1.5 \ -0.5 \ 1]^T$                        | $d_1 = -1$ | 3 | $x_3 = [-1 \ 1 \ 0.5 \ 1]^T$ | $d_1 = 1$ |
| Iteration                                                                                                                                                                                                                                                                                                                                                                                                                                 | Inputs                         | Desired outputs                                                                                                                                                                                                                                                                                                                     |                   |     |           |                                                            |                 |                                                             |                            |                                                  |          |                                                       |            |   |                              |           |
| 1                                                                                                                                                                                                                                                                                                                                                                                                                                         | $x_1 = [1 \ -2 \ 0 \ 1]^T$     | $d_1 = -1$                                                                                                                                                                                                                                                                                                                          |                   |     |           |                                                            |                 |                                                             |                            |                                                  |          |                                                       |            |   |                              |           |
| 2                                                                                                                                                                                                                                                                                                                                                                                                                                         | $x_2 = [0 \ 1.5 \ -0.5 \ 1]^T$ | $d_1 = -1$                                                                                                                                                                                                                                                                                                                          |                   |     |           |                                                            |                 |                                                             |                            |                                                  |          |                                                       |            |   |                              |           |
| 3                                                                                                                                                                                                                                                                                                                                                                                                                                         | $x_3 = [-1 \ 1 \ 0.5 \ 1]^T$   | $d_1 = 1$                                                                                                                                                                                                                                                                                                                           |                   |     |           |                                                            |                 |                                                             |                            |                                                  |          |                                                       |            |   |                              |           |